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If now, using Fig. 1 in a new way, (*c*) be taken as the product of (*a*) and (*b*) by multiplication of ordinates, we readily obtain, by a similar method of proof, the result,

$$\frac{dy}{dx}=u\frac{dv}{dx}+v\frac{du}{dx}.$$

This result is expressed to the eye by a figure similar to Fig. 4, wherein the number of linear spaces in Tt=(the number of linear spaces in OM)×(the number in $T't'$)+(number in $T''t''$)×(the number in AM).

Thus when the slopes of two curves are known, that of their product can be at once written down.

In this way all the ordinary formulas of differentiation are obtained as applied to curves.

The student should now be introduced to the idea of function, that is of quantity independent of any spacial relations, and brought to see the greater freedom and flexibility of treatment obtained by its use.

(TO BE CONTINUED.)

ARITHMETIC.

Conducted by B. F. FINKEL, Kidder, Missouri. All contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

1. I. Reduce $\frac{1}{3}$ to 8ths.

1st Solution.

$$\text{II.}\begin{cases}1. & 1=8 \text{ eighths.}\\ 2. & \frac{1}{3}=\frac{1}{3}\text{ of 8 eighths}=2\frac{2}{3}\text{ eighths.}\end{cases}$$

III. ∴ $\frac{1}{3}=2\frac{2}{3}$ eighths, or $\frac{2\frac{2}{3}}{8}$.

2nd Solution.

$$\text{II.}\begin{cases}1. & 1=\frac{8}{8}.\\ 2. & \frac{1}{3}=\frac{1}{3}\times\frac{8}{8}=\frac{2\frac{2}{3}}{8}.\end{cases}$$

III. ∴ $\frac{1}{3}=\frac{2\frac{2}{3}}{8}$.

2. I. Reduce $\frac{5}{6}$ to a fraction whose numerator is 11.

$$\text{II.}\begin{cases}1. & 1=\frac{11}{11}\\ 2. & \frac{5}{6}=\frac{5}{6}\times\frac{11}{11}=\frac{11}{\frac{55}{6}}=\frac{11}{9\frac{1}{6}}.\end{cases}$$

III. ∴ $\frac{5}{6}=\frac{11}{9\frac{1}{6}}$, a fraction whose numerator is 11.

3. **Proposed by L. B. Hayward, Superintendent of Schools, Bingham, Ohio.**

Bought an article and sold it for 3% less than it cost me; bought it back paying 3% more than I sold it for. I lost $12.00 by the transaction. What did the article cost at first?

Solution by the Proposer.

Let 100% = the cost at first.

Then 97% = selling price.

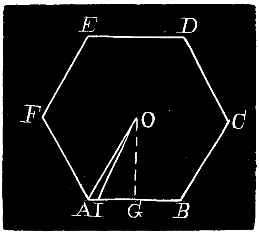
And 3% of .97=.02 $\frac{91}{100}$.
97%+2$\frac{91}{100}$%=99$\frac{91}{100}$%=cost on repurchasing.
Loss is 100%−(97−2$\frac{91}{100}$)%=5$\frac{91}{100}$%.
∴ 5$\frac{91}{100}$%=$12.00.
Then 1%=$2.0305.
And 100%=$203.05.

4. I. What is the number of acres in a field in the form of a regular hexagon, if it contains as many acres as there are boards in the fence inclosing it, the boards being $l=8\sqrt[4]{3}$ feet long and the fence $n=6$ boards high?

Solution by B. F. FINKEL, Professor of Mathematics in Kidder Institute, Kidder, Missouri.

Construction.— Let $ABCDEF$ be the field, O the center, AI the length of a panel of the fence. Connect A and I with the center of the field by the lines AO and IO. Draw OG perpendicular to the side AB. Then

II.
1. $AI=8\sqrt[4]{3}$ feet, and
2. *area* of $AOI=6A=261360$ sq.ft., since there are as many acres in the field as there are boards in the fence inclosing it and the panel being 6 boards high.
3. $\frac{1}{2}(AI\times OG)=$the area of the triangle $AOI=\frac{1}{2}(8\sqrt[4]{3}\times OG)=4\sqrt[4]{3}\times OG$.
4. $\therefore 4\sqrt[4]{3}\times OG=261360$, the number of square feet in the triangle AOI, whence
5. $OG=261360\div4\sqrt[4]{3}=\dfrac{65340}{4\sqrt[4]{3}}$. But
6. $OG=\sqrt{[AO^2(=AB^2)-AG^2(=\frac{1}{2}AB)^2\ ]}=\frac{1}{2}AB\sqrt{3}$.
7. $\therefore \frac{1}{2}AB\sqrt{3}=\dfrac{65340}{4\sqrt[4]{3}}$, whence
8. $AB=\dfrac{130680}{\sqrt[4]{3^3}}$ ft., the length of a side of the field. Then
9. $\dfrac{130680}{\sqrt[4]{3^3}}\div8\sqrt[4]{3}=5445$, the number of panels on a side, and
10. $6\ (6\times5445)=196020$, the number of acres in the field.



III. ∴ There are 196020 acres in the field.

Remark.— If we let $l=$the length of a rail and n, the number of rails in a panel, the number of acres in a hexagonal field will be $174240n^2\div l^2\sqrt{3}$. From the nature of the problem, n must be integral. ∴ The number of acres and the length of the rails can not both be rational. The above solution is also applicable when the field is in the form of a square.

PROBLEMS.

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5. **Proposed by E. E. KINNEY, Anaconda, Montana.**

A board is 16 in. long and 9 in wide. How may it be cut in two parts that the parts joined together may form a square?